Smog

Subjects: Science, Health
Grades: 3-8
Teaching Time: 30 minutes
Focus: Cars, weather, health effects of air pollution

Rationale

Two pollutants emitted by motor vehicles react to form ground-level ozone or smog which can cause respiratory problems and reduce visibility.

Learning Objectives

Students will:

- Understand how "real" smog occurs.
- Understand the connection between vehicle use and smog
- Use a model of smog to learn about its appearance and behavior
- Know the health effects of smog

Teacher Background

When the sun heats two types of air pollutants (hydrocarbons and oxides of nitrogen), it causes a chemical reaction that produces ground-level ozone (O3), often called "smog" from a combination of the words "smoke" and "fog." (This ozone is different from the thin layer of atmospheric ozone that protects the earth from harmful ultraviolet radiation. See the Appendix for Focus sheet #F-A-93-07, "Ozone.")

Over two-thirds of the smog-producing pollutants come from vehicles; most of the rest come from smoke stacks and fumes from chemical solvents. Thermal inversions (see the activity, "Lighter Than Air") or a lack of wind can cause smog to be trapped over an area. In addition to reducing visibility, smog has effects on our health including irritation of the respiratory system; reduced resistance to lung infections; and aggravation of asthma, emphysema, and bronchitis.

In this activity, students will not create ozone smog, but rather a model of smog that will demonstrate what it looks like and how it behaves. It mimics the conditions that existed in London in the late 1800s, when the term "smog" was first used to describe the haze produced by the condensation of water vapor on soot particles.

Materials (for each group)

- Clean, dry wide-mouth canning or mayonnaise jar
- Heavy-duty aluminum foil (6" x 6" square)
- 2 - 3 ice cubes
- 6" x 2" strip of paper
- Matches
- Salt

Pre & Post Test Questions

1. What is smog and how does it occur? (Ground-level ozone haze; formed by sunlight causing a reaction between two gaseous air pollutants, hydrocarbons and nitrous oxide.)

2. How does vehicle use affect smog levels? (Over two-thirds of smog-producing chemicals come from vehicles.)

3. What are some of the health effects of smog? (Irritation of respiratory system; reduced resistance to lung infections; aggravation of asthma, emphysema, and bronchitis.)

Learning Procedure

CAUTION: Students will need close supervision with matches. This is perhaps done best as a demonstration with younger children. Be sure to have a fire extinguisher close at hand. DO NOT let anyone breathe the "smog," and release it outside when the experiment is over.

1 Ask students for examples of how sunlight can change substances (melt wax/plastic, fade colors, melt ice, cook food in solar cooker, etc.). Explain that sunlight also produces some changes that we are less aware of, including changing two of the pollutants that come from our cars into a gas that's harmful at ground level, ozone. Distinguish between the ozone layer that protects the Earth from ultraviolet radiation, and ground-level ozone, a harmful pollutant. Tell students that this ground-level ozone is called smog, and that today they will be making, not real smog, but a model of it to show what it looks like and how it acts.

2 Divide students into groups of 3-4. Have one person from each group fold the piece of paper in half lengthwise and twist it into a rope.

3 Other group members should make a snug lid for the jar out of the piece of aluminum foil. Be sure to make a slight depression in which the ice cubes can rest without sliding off. Remove the lid and set aside.

4 Have students put a little water in the jar, swish it around to wet the whole inside of the jar, and pour it out.

5 Have students light the paper rope with a match, and drop it AND the match into the moist jar. Then, QUICKLY put the foil lid back on the jar, seal tightly, and put the ice cubes on top of the lid. (This will make the water vapor condense.) Sprinkle a little salt on the ice to help it melt.

6 Students should watch what happens and be ready to describe it. Discuss how what you have observed is like real "smog" and how it is different. (Like: decreases visibility, produced by air pollution; Unlike: soot and water vapor are interacting in the model, rather than hydrocarbons and oxides of nitrogen and the smog isn't ozone.)

7 Ask students for times that they might have noticed decreased visibility due to smog.

8 Ask students how smog might/does affect their health. Tell them about the three main health effects of smog.